While principles of the present invention have been illustrated and described herein as being representatively incorporated in a gas-fired water heater, it will readily be appreciated by those skilled in this particular art that such principles could also be employed to advantage in other types of fuel-fired heating appliances such as, for example, boilers and other types of fuel-fired water heaters. Additionally, while a particular type of combustion air inlet flow path has been representatively illustrated and described in conjunction with the water heaters 10, 10a and 10b, it will also be readily appreciated by those skilled in this art that various other air inlet path and shutoff structure configurations could be utilized, if desired, to carry out the same general principles of the present invention.

The foregoing detailed description is to be clearly understood as being given by way of illustration and example only, the spirit and scope of the present invention being limited solely by the appended claims.

WHAT IS CLAIMED IS:

1. Fuel-fired heating apparatus comprising:

a combustion chamber thermally communicatable with a fluid to be heated;

a burner structure associated with said combustion chamber and operative to receive fuel from a source thereof;

a wall structure defining a flow path through which combustion air may flow into said combustion chamber for mixture and combustion with fuel received by said burner structure to create hot combustion products within said combustion chamber; and

a combustion air shutoff system for terminating combustion air supply to said combustion chamber in response to the presence of a predetermined elevated temperature therein, said combustion air shutoff system including:

a temperature sensing structure extending into the interior of said combustion chamber and having a frangible portion disposed within said combustion chamber and being shatterable in response to exposure to said predetermined elevated temperature, and

a damper disposed externally of said combustion chamber and operatively associated with said frangible portion, said damper being (1) movable between an open position in which said damper member permits combustion air to flow into said combustion chamber via said flow path, and a closed position in which said damper precludes combustion air flow into said combustion chamber via said flow path, (2) resiliently biased toward said closed position, and (3) blockingly held in said open position by said frangible portion which, when shattered, permits movement of said damper to said closed position.

2. The fuel-fired heating apparatus of Claim 1 wherein:
said fuel-fired heating apparatus is a fuel-fired water heater.

3. The fuel-fired heating apparatus of Claim 2 wherein:
said fuel-fired water heater is a gas-fired water heater.

4. The fuel-fired heating apparatus of Claim 1 wherein:
said combustion air shutoff system is operative, in response to an increased combustion temperature within said combustion chamber created by a reduction in the quantity of combustion air entering said combustion chamber via said flow path, to terminate combustion air supply to said combustion chamber prior to the creation therein of a predetermined elevated concentration of carbon monoxide.

5. The fuel-fired heating apparatus of Claim 4 wherein:
said predetermined elevated concentration of carbon monoxide is in the range of from about 200 ppm to about 400 ppm by volume.

6. The fuel-fired heating apparatus of Claim 4 wherein:
said fuel-fired heating apparatus is a fuel-fired water heater.

7. The fuel-fired heating apparatus of Claim 6 wherein:
said fuel-fired water heater is a gas-fired water heater.

8. The fuel-fired heating apparatus of Claim 1 wherein:

said burner structure is disposed within said combustion chamber, and

said temperature sensing structure is positioned adjacent said burner structure.

9. The fuel-fired heating apparatus of Claim 1 wherein:

said frangible portion includes a frangible glass bulb member filled with a fluid.

10. The fuel-fired heating apparatus of Claim 9 wherein:

said fluid is peanut oil.

11. The fuel-fired heating apparatus of Claim 9 wherein:

said fluid is mineral oil.

12. The fuel-fired heating apparatus of Claim 9 wherein:

said fluid is an assembly lubricant.

13. The fuel-fired heating apparatus of Claim 1 wherein said temperature sensing structure includes:

a frame structure disposed within said combustion chamber and operatively supporting said frangible portion, and

a rod having a first end portion anchored to said damper for movement therewith between said open and closed positions, and a second end portion movably received in said frame structure and longitudinally facing said frangible portion,

said frangible portion, until shattered, preventing movement of said rod toward said frame structure.

14. The fuel-fired heating apparatus of Claim 13 wherein said temperature sensing structure further includes:

a spring member resiliently interposed between said frangible portion and said second end portion of said rod.

15. The fuel-fired heating apparatus of Claim 1 wherein:

said combustion chamber has an outer wall portion defined by an arrestor plate having flame quenching openings therein, and

said temperature sensing structure extends into the interior of said combustion chamber through said arrestor plate.

16. The fuel-fired heating apparatus of Claim 15 wherein:

said flame quenching openings have hydraulic diameters, and said arrestor plate having a thickness, and

the ratio of said hydraulic diameters to said thickness is in the range of from about 0.75 to about 1.25.

17. The fuel-fired heating apparatus of Claim 16 wherein:

said ratio is approximately 1.0.

18. A method of operating a fuel-fired heating apparatus having a combustion chamber, a burner structure operative to create hot combustion products in said combustion chamber, and a flow path external to said combustion chamber and operative to deliver combustion air into said combustion chamber, said method comprising the steps of:

sensing an undesirable temperature increase in said combustion chamber caused by a reduction in air flow through said flow path into said combustion chamber which increases the level of carbon monoxide created in said combustion chamber during firing of said burner structure; said sensing step being performed using a temperature sensing structure projecting into said combustion chamber and supporting within said combustion chamber a heat-frangible element shatterable at a set point temperature; and

responsively terminating combustion air flow through said flow path in a manner terminating burner combustion prior to the concentration level of carbon monoxide in said combustion chamber reaching a predetermined magnitude.

19. The method of Claim 18 wherein:

said step of responsively terminating combustion air flow through said flow path is performed using a spring-loaded damper member held in an open orientation by said temperature sensing structure until said heat-frangible element is shattered.

20. Fuel-fired heating apparatus comprising:

a combustion chamber thermally communicatable with a fluid to be heated, said combustion chamber having an outer wall defined by an arrestor plate having a perforated portion defined by flame quenching openings formed in said arrestor plate;

a burner structure disposed in said combustion chamber and operative to receive fuel from a source thereof;

a wall structure defining a flow path external to said combustion chamber and through which combustion air may flow into said combustion chamber for mixture and combustion with fuel received by said burner structure to create hot combustion products within said combustion chamber;

a damper structure disposed externally of said combustion chamber and being resiliently biased toward a closed position in which it terminates air flow through said flow path; and

a temperature sensing structure projecting into said combustion chamber and supporting a heat-frangible element within the interior of said combustion chamber, said temperature sensing structure releasably blocking said damper structure in an open position in which it permits combustion air to flow through said flow path into said combustion chamber, and being operative to unblock said damper structure, and permit it to be driven to its closed position, in response to the shattering of said heat-frangible element caused by the presence of a predetermined, undesirably high temperature in said combustion chamber during firing of said burner structure.

21. The fuel-fired heating apparatus of Claim 20 wherein:

said fuel-fired heating apparatus is a gas-fired water heater.

22. The fuel-fired heating apparatus of Claim 20 wherein:
said frangible element is a fluid-filled glass bulb.

23. The fuel-fired heating apparatus of Claim 22 wherein:
said glass bulb is filled with peanut oil.

24. The fuel-fired heating apparatus of Claim 22 wherein:
said glass bulb is filled with mineral oil.

25. The fuel-fired heating apparatus of Claim 22 wherein:
said glass bulb is filled with an assembly lubricant.

26. The fuel-fired heating apparatus of Claim 20 wherein said temperature sensing structure includes:

a frame structure secured to the inner side of said arrestor plate and supporting said heat-frangible element,

a rod having a first end portion anchored to said damper structure for movement therewith, and a second end portion movably received by said frame structure and facing said heat-frangible element, movement of said rod by said damper structure toward said frame structure being precluded by said heat-frangible element until it is shattered by heat within said combustion chamber.

27. The fuel-fired heating apparatus of Claim 26 wherein said temperature sensing structure further includes:

a spring member resiliently interposed between said heat-frangible element and said second end portion of said rod.

28. The fuel-fired heating apparatus of Claim 27 wherein:

said frame structure includes a first portion secured to the inner side of said arrestor plate, and a second portion removably secured to said first portion and carrying said heat-frangible element and said spring member.

29. The fuel-fired heating apparatus of Claim 28 wherein:

said second portion of said frame structure is removably secured to said first portion of said frame structure by a twist-lock connection therebetween.

30. Combustion air shutoff apparatus for a fuel-fired heating appliance, comprising:

a frame structure having spaced apart opposing first and second wall portions and a passage extending through said first wall portion;

a heat-frangible element bearing against said second wall portion; and

a spring member releasably interposed between said first wall portion and said heat-frangible element, resiliently holding said heat-frangible element against said second wall portion, and overlying and blocking said passage.

31. The combustion air shutoff apparatus of Claim 30 further comprising:

a rod having a first end portion, and a second end portion insertable into said passage, toward said spring member, to forcibly bear against said spring member.

32. The combustion air shutoff apparatus of Claim 31 further comprising:

a damper member anchored to said first end portion of said rod.

33. The combustion air shutoff apparatus of Claim 30 wherein:

said heat-frangible element is a fluid-filled glass bulb.

34. The combustion air shut-off apparatus of Claim 33 wherein:

said glass bulb is filled with peanut oil.

35. The combustion air shut-off apparatus of Claim 33 wherein: said glass bulb is filled with mineral oil.

36. The combustion air shut-off apparatus of Claim 33 wherein: said glass bulb is filled with an assembly lubricant.

37. Combustion air shutoff apparatus for a fuel-fired heating appliance, comprising:

a first frame member having spaced apart opposing first and second wall portions and a first passage extending through said first wall portion;

a heat-frangible element releasably carried by said first frame member and bearing against said second wall portion;

a spring member releasably interposed between said first wall portion and said heat-frangible element, resiliently holding said heat-frangible element against said second wall portion, and overlying and blocking said passage; and

a second frame member having a base wall with a second passage extending therethrough;

said first frame member being releasably securable to said second frame member in a manner positioning said first wall portion in an overlying relationship with said base wall, with said first and second passages being aligned with one another.

38. The combustion air shutoff apparatus of Claim 37 further comprising:

a rod having a first end portion, and a second end portion insertable through said first and second passages, toward said spring member, to forcibly bear against said spring member.

39. The combustion air shutoff apparatus of Claim 31 further comprising:

a damper member anchored to said first end portion of said rod.

40. The combustion air shutoff apparatus of Claim 37 wherein:

said heat-frangible element is a fluid-filled glass bulb.

41. The combustion air shutoff apparatus of Claim 40 wherein:

said glass bulb is filled with peanut oil.

42. The combustion air shutoff apparatus of Claim 40 wherein:

said glass bulb is filled with mineral oil.

43. The combustion air shutoff apparatus of Claim 40 wherein:

said glass bulb is filled with an assembly lubricant.

44. The combustion air shutoff apparatus of Claim 37 wherein:

said first and said second frame members are configured to be releasably secured to one another using a twist-lock interconnection therebetween.

45. The combustion air shutoff apparatus of Claim 44 wherein:

said base wall of said second frame member has opposite transverse end tabs with slots therein, and

said first wall portion of said first frame member has end tabs which are rotatable into said slots for releasable retention therein.